

A N
E S S A Y
ON THE
THEORY AND PRACTICE
O F
MEDICAL ELECTRICITY.

B Y
TIBERIUS CAVALLO, F. R. S.

L O N D O N:
PRINTED FOR THE AUTHOR,

M.DCC.LXXX.

TO THE

EDUCATED AND DISCREET

OF THE MEDICAL PROFESSION

THEORY AND PRACTICE

OF

MEDICAL ELECTRICITY

BY

THEOPHILUS CAVALLI, F.R.S.

LONDON:

PRINTED FOR THE AUTHOR.

M.DCCCXXXV

TO THE
RIGHT HONOURABLE
JOHN EARL OF BUTE,
&c. &c.

THIS ESSAY ON
MEDICAL ELECTRICITY

I S,
WITH THE GREATEST RESPECT,
INSCRIBED,

BY HIS LORDSHIP'S

MOST OBEDIENT, AND

MOST HUMBLE SERVANT,

THE AUTHOR.

T H E

P R E F A C E.

TH E medical application of Electricity, as it was practised till very lately, and as it is still used by various persons, was attended with two remarkable inconveniences. The first was the administration of strong shocks, which terrified many a patient; and the second was a long continuance of

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the application, which was tiresome both for the patient, and for the practitioner and his assistant. But the present practice, established upon experience, has happily removed those inconveniences; it having been observed, that the disagreeable strong shocks are not only useless, but also dangerous in various cases; and that shocks in general may be almost entirely omitted. As for the continuance of the application of Electricity, there are indeed some few cases, in which a long continued electrization seems promising; but in general the application of that power for two or three minutes per day, has been found to be quite sufficient.

Thus

Thus Medical Electricity has been rendered more useful, and more agreeable. But this improved method of applying Electricity is at present confined to a few practitioners; the rest following the old method, or rather no method at all. It was therefore deemed necessary to compile the present Essay, in order not only to instruct the unskilled practitioners, but also to satisfy the curiosity of the public in general, especially because this subject is at present much talked of.

In the first part, containing the Theory of Medical Electricity, the author has omitted to mention those

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those hypotheses, which have been offered in several publications, and which are easily disproved ; because they would have answered no other purpose but that of swelling the work.

The second part contains principally the description and use of those instruments, which answer all the required purposes in Medical Electricity, and which may be easily procured, or made without much trouble or ingenuity.

In the third part the author has endeavoured to express in a few words, the result of a vast number of experiments and cases, either
5 published

published in print, or communicated to him by the best practitioners, who have had a very extensive practice; and who, it is but justice to confess, have made him acquainted with every useful particular they could furnish for the improvement of Medical Electricity, and that with a gentility and frankness that does honour to the philosophical world.

In the Appendix the author has collected all those particulars, which seem likely to furnish new hints for the advancement of the subject; which, although much improved at present, is perhaps still in its infancy.

Lastly,

Lastly, to render this Essay more intelligible and useful, a Copper Plate has been added to it; exhibiting a delineation of all the new instruments that are used in Medical Electricity.

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CORRECTIONS and ADDITIONS.

Page 2. line 23. *for* and a lefs *read* and
lefs.

3. 1. *for* interest is *read* interest
it is.

8. 4. *for* But the power of elec-
tricity is immaterial whe-
ther it passes *read* But it is
of no consequence whether
the power of electricity
passes.

40. 26. *for* on the *read* or the.

59. 10. *for* electrizations *read*
electrization.

70. 6. *for* a wall *read* a ball of
fire.

To the description of the directors in
page 30, &c. there should be added, that
sometimes they are made with very slender
and annealed wires, so that they may be
bended in every required direction.

It may be also useful to observe, that not only sparks but also the stream of electric fluid may be drawn with those directors, whose use is described in page 38. This is done by bringing (instead of the knuckle) a pointed piece of wood near the small knob H or G of the director; every thing else being disposed as it is directed in page 38.

A N
E S S A Y
ON THE
THEORY AND PRACTICE
OF
MEDICAL ELECTRICITY.

P A R T I.

The Theory of Medical Electricity.

THE wonderful effects of that unknown cause generally named Electricity, soon after the discovery of the electrical machines, were applied as a remedy for various disorders incident to the human body. The first hints of this application, seem to have been suggested by observing the effects produced upon those persons that were electrified for curiosity ; who being generally afraid of that extraordinary power, attributed intirely to it, all those effects, which might in great measure have been attributed to fear and apprehension : such were an increased per-
B spiration,

spiration, heat, increase of pulsation, &c. The number of patients that were electrified at that time, is prodigious, and the pretended cures effected by it were wonderful indeed. Accounts of those miracles performed by electricity, were published in various parts of Europe, together with the methods of electrifying the patients; to which were added, such theories as, allowance being made for the infancy of electricity at that time, would seem impossible ever to have been proposed to the public. Those theories were often enforced by the account of experiments, which often proved false upon examination *. Indeed if electrical machines could not be procured at present, we could hardly entertain any doubt concerning the veracity of those accounts, which had all the appearance of authenticity. But at present a much better acquaintance with the science of electricity, than philosophers had about thirty or forty years ago, and a less faith in the accounts of the generality of those persons, whose

* The medicated cylinders for electrical machines, are a remarkable instance of this kind. See Dr. Priestley's History of Electricity.

interest is to promote the use of electricity in medicine, has pointed out the real effects of that power upon the human body, in various circumstances, and has shewn how far we may confide in it; establishing, upon indisputable facts, that the power of electricity is neither that admirable panacea, as it was considered by some fanatical and interested persons, nor so useless on application as others have asserted; but that when properly managed, it is an harmless remedy, which sometimes instantaneously removes divers complaints, generally relieves, and often perfectly cures various disorders, some of which could not be removed by the utmost endeavours of physicians and surgeons.

When the first rumor occasioned in Europe by the accounts of pretended, and a few real wonders, performed by means of electricity, had in some measure subsided, many creditable and experienced physicians, who justly considering it as their duty, had undertaken to examine the power of this new remedy, published some unsuccessful applications of electricity in

divers diseases ; in which cases, they had not only prescribed the electrization, but the operation had been performed either by themselves, or under their inspection. These publications gave a new turn to the reputation of medical electricity ; and since that time, the generality of physicians and surgeons had not the least regard for the medical application of electricity ; so that the practitioners of it were rather considered as fanatics and impostors. However, an attentive examination of this subject, after several trials, and after overcoming in great measure the rooted prejudice amongst physicians, began to establish anew the reputation of medical electricity ; and shewed that many applications of electricity, published in the above-mentioned accounts, had proved unsuccessful, because the operation was not managed properly ; so that it had been the abuse, and not the use of electricity, that had proved unsuccessful, and in some cases even detrimental ; for at that time, strong shocks and strong sparks were generally administered, which a long series of experiments and observations have proved

proved to be generally useless or hurtful. Mr. Lovet, who practised medical electricity for a long time, was, as far as I know, the first who protested against the use of strong shocks; and in an essay of his, intituled, *Subtil Medium proved*, asserts, that the shocks to be used in medical electricity should be very small; by which treatment he hardly ever failed of curing, or at least relieving his patients.

Electricity, different from other physical applications, requires rather a nicety of operation than a thorough knowledge of the disease. That it is possible to apply electricity properly, without a just knowledge of the disorder, may seem a paradox; but it will be presently shewn, that to electrify a sound part of the body together with the diseased one, is by no means prejudicial, and that the degree of electrization must be regulated rather by the feeling of the patient, than by the species of disorder; from whence it must follow, that the application of medical electricity may be properly managed even with a superficial

knowledge of the disorder. It must, however, be confessed, that farther experience may possibly shew much easier and more certain methods of applying it differently for different diseases; and therefore it is more likely that medical electricity will receive improvements in the hands of skilful physicians or surgeons, than when managed by ignorant persons, whose success is intirely trusted to chance.

The remarks made by philosophers relating to the effects of electricity upon the human body in general, are the following: viz. that by electrization the pulse of a person is quickened; and that glandular secretion and the insensible perspiration are promoted, and often even restored, when they had been intirely obstructed. It might be easily suspected, that the promotion of perspiration and of glandular secretion, were only the consequence of the accelerated pulsation, and not the immediate effect of electricity: but the contrary is easily proved, by observing, that in various cases, the quickening of the pulsation by other means in-

depen-

dependent of electricity, as fear, exercise, &c. did not promote those secretions nearly so much, if at all, as electrization ; and also that glandular secretion and perspiration are often promoted by electricity, when applied only to a particular part of the body, in which case it seldom, if ever, accelerates the pulsation.

Hitherto it has not been discovered that the electric fluid acts within the human body by any chymical property, as other medicines generally do ; but its action, by which it produces the above-mentioned effects, may be considered merely as a mechanical stimulus ; for it seems to act as such, even within those parts of the body which, especially when diseased, are mostly out of the reach of other remedies.

The superiority of electricity over other remedies, in many cases, may appear from considering, that medicines in general cannot always be confined to a particular part of the body, and to let them pass through other parts is often dangerous, for which reason they cannot be used ; besides, after

that those medicines have exerted their required power, they are with great difficulty, if at all, separated from the body. But the power of electricity is immaterial, whether it passes through this or that other part of the body in order to come at the seat of the disease, and after having exerted its action, it is instantly dispersed: hence it appears why electricity has often cured such obstinate disorders as have not yielded to any other treatment.

Formerly, in order to stimulate, or in general to apply electricity to any diseased part of the human body, strong shocks, or at least very pungent sparks, were thought necessary; but at present it is very reasonably established, upon experience, that the greatest electric powers which can be applied with good expectations, are exceedingly small shocks and moderate sparks, the proper force of which will be particularly described in the sequel; but that in general, the most proper treatment is, to throw the fluid, by means of a wooden point, as it is commonly called, or merely by a metallic point; in which last case, the

the person electrified feels only a gentle wind upon that part of the body towards which the point is directed.

By considering the above-mentioned effects of electricity, one may naturally suspect, that in cases of preternatural discharges, the application of electricity would be rather injurious than beneficial; because in those cases the discharge is required to be suppressed, and not promoted. In respect to this important point, it has been observed, that if strong shocks, or very pungent sparks, are given to the patients afflicted with those discharges, the disease is seldom cured, and on the contrary it is often increased; but when only the fluid is drawn from the part, by means of a wooden point, or at most exceedingly small shocks be administered when the seat of the disease is more internal, then the discharge, &c. is at first generally promoted for a few days or hours, according to the nature of the disease and other circumstances, but afterwards it lessens by degrees, till it is quite cured. In cutaneous eruptions, the application of elec-

3 tricity

tricity is generally attended with similar effects.—The eruption first spreads farther for a short time, and afterwards lessens by degrees till it quite vanishes. From these observations it appears, that the application of electricity, when judiciously managed, does not merely promote any discharge or circulation of fluids, but rather assists the *vis vitæ*, or that innate endeavour, by which nature tends to restore the sound state of the injured parts of a living animal,

It may perhaps be ever difficult to explain in what manner electricity assists that natural endeavour; but experience shews the certainty of the fact, and with it we must be gratefully contented; for we may apply the effects to our wants, though we are ignorant of their cause, and of its mode of acting. When an electric shock is sent through any part of the body, an instantaneous involuntary motion or convulsion is occasioned, which shews that the muscular fibres through which the shock is sent, are expanded, or in some other manner convulsed. This involuntary

tary motion, though not so strongly, is occasioned also by sparks, and often even by drawing the fluid.—Farther, when a shock is sent through or over several substances besides the human body, a tremulous motion and an expansion is evidently occasioned, as it may be shewn by many electrical experiments. Now all these observations may perhaps, in a manner, explain the action of electricity upon the organized parts of an animal body, by comparing it with the tremulous motion given to pipes of any sort, through which fluids are transmitted, in order to accelerate their passage, and to prevent any stoppage, which might arise from stagnation or accumulation of gross bodies. Perhaps the reason why strong shocks are generally hurtful, may be because the irritation they give to the obstructed parts, especially when they are very minute and delicate, breaks their organization; the force being greater than that those parts can naturally bear.

Independent of undeniable practical observations, when it is only admitted that
 electricity

electricity promotes natural secretions and circulation, which it certainly does, there follows, that its application must be beneficial in cases of unnatural discharges; for in those cases the discharge is occasioned by the obstruction of the natural ways; but electricity removes those obstructions, which is the same thing as to promote natural secretion and circulation; therefore, it must suppress the unnatural discharge, which can no longer exist when the natural course of the fluids has been restored.

It has been confidently affirmed by some philosophers, that electrization increases the number of pulsations about one sixth: so that if the pulse of a person naturally beats eighty times in a minute, after being electrized for a few minutes, it will beat about ninety-four times *per* minute. Others have said, that the increase of the number of pulsations is more than a sixth; and some persons have even said, that the pulse is not at all increased. In the New Memoires of the Royal Academy at Berlin, for the year 1772, there is a paper of M. Gerhard,

Gerhard, concerning the action of electricity upon the human body; in which the author observes, that electrization sometimes quickens the pulse so much as to double the number of pulsations; and sometimes retards it considerably. It has also been asserted, that positive electricity accelerates the pulse; and that on the contrary, negative electricity retards it. But experience authorizes me to say, that this effect varies considerably, according to the degree of electrization, and principally according to the natural disposition of the person tried, and the degree of apprehension with which he subjects himself to be electrified; but that in general, either positive or negative electrization increases the number of pulsations about one sixth, as it was observed above*.

As for the other above-mentioned effects of electricity, they are more cer-

* The method of electrization here meant, is, to insulate the person upon a stool, furnished with glass legs, and to keep him connected with the prime conductor, or with the rubber of a pretty powerful electrical machine whilst in motion.

tain, and less depending upon fear and apprehension. The involuntary motion, for instance, the increase of perspiration, &c. are by no means avoided by intrepidity, and acquaintance with the science of electricity. Thus a person who has often felt electric shocks, may receive them without fear, but he will be convulsed, and will feel them as well as those who have not been conversant with them ; although the latter generally suppose to have felt a greater sensation than they really have, which is certainly the effect of apprehension, and is commonly removed after the first or second trial.

With respect to diseases in general, two states of the affected parts should be considered. The first is, the immediate and recent cause of the disease; and the second state is, the alteration of other parts, especially solid, which is occasioned by the long continuance of the first and principal cause; thus, for instance, the weakness or rupture of some vessels within the body, may occasion extravasation of fluids, which is the first state of the disease.

ease. Now if these extravasated fluids continue in any part of the body, they will gradually occasion a suppuration, an inflammation, or other symptoms, which vary according to innumerable circumstances. This we may consider as the second state of the disease. Again, when a palsy deprives a part of the body of its motion, the fleshy and even the more solid parts, in process of time, waste and become disfigured, which is the effect of the obstructed motion and circulation, and which we may therefore consider as the second state of the disease; and so of the rest. Now it has been observed, that the power of electricity often removes the first state of the disorder; but the latter is very seldom cured by it. Indeed it seems almost impossible that a disfigured bone or destroyed organization should be restored to its sound state by means of electricity. Dr. FRANKLIN having electrified several paralytic persons in America, observed that they were generally relieved for a few days on the beginning, but that they afterwards either did not mend, or relapsed

into the state, they were before the use of electricity *. Here it must be observed, that those paralyties were mostly of a long standing, and also that the method practised by the Doctor, was to give strong shocks, which we have already remarked to be rather prejudicial.

In general the application of electricity has been found to be of very little use in cases of long standing; because, as we observed above, the more solid parts, by the long continuance of the disorder, have undergone such alteration, as cannot be restored by a mere stimulus, such as the electric action is supposed to be. However, sometimes diseases of many years standing have been perfectly cured by means of electricity. In these cases therefore, although there may be less hope of effecting a cure, it is not improper to apply the power of electricity, which, when judiciously managed, does never produce any bad effects.

* See Dr. Franklin's Philosophical Letters, Papers, &c. and Dr. Priestley's Hist. of Electricity.

Hitherto

Hitherto I do not know that any authentic facts have shewn any difference between the application of different kinds of electricity in medical cases. Whether the patients be electrified by the prime conductor, or by the insulated rubber of the usual electrical machines, viz. whether they are electrified positively or negatively, seems to be quite indifferent: hence, admitting Dr. Franklin's hypothesis of electricity, we see that it is not the direction of the electric fluid that determines the fluids of the body one way or the other; but that the effects usually observed upon the body when electrized, must be owing to the irritation, or dilatation, occasioned by the action of that fluid.

Before we conclude the first part of this work, it will be proper to mention a few hints, which may promote the investigation of the action of the electric fluid, especially relating to its chymical action; viz. if it adds any principle to those parts through which it passes, as an acid, an alkali, the inflammable principle,

C

&c.

&c. The observations relating to this point are, first, that when any part of the body has been exposed to the stream of electric fluid, it acquires a sulphurous, or rather a phosphoric smell, which it retains for a considerable time. Secondly, when the stream of electric fluid, issuing from a point, is directed towards the palate, a kind of acid taste is perceived. Now this smell and taste indicate, that the electric fluid either alters the parts of the body, upon which it excites those sensations, or that it carries along with itself some other principle, which may perhaps be separated from those substances, through which this fluid passes, previous to its impinging upon the body.—Whether those effects may be increased, diminished, or turned to any use, and also whether they are quite indifferent with respect to medical electricity, are matters that require farther experiments and consideration; for nothing of certain has been yet determined respecting them.

In various experiments, when the electric spark is taken in air, or other fluids,
especially

especially the tincture of certain flowers, shews effects similar to those, which the inflammable principle, or an acid, produces upon those fluids. These experiments have induced various persons to suppose, that the electric fluid is phlogiston, or an acid, or else a compound of both. But considering that in those cases, the action of the electric fluid as an acid, or as phlogiston, is exceedingly small; and also considering the violence with which it passes through the substance of bodies, the surfaces of which it generally burns or melts in a small degree; it seems more natural to suspect, that the above-mentioned effects are produced by that quantity of inflammable or acid principle, which the violent passage and escape of the electric fluid detaches from other bodies, rather than to consider the electric fluid itself to be an acid or the inflammable principle, which seems to be very unlikely on various other accounts besides.

P A R T II.

*Directions for the practical application
of Electricity for the Cure of various
Diseases.*

OMITTING the description of the electrical machine, and the manner of preserving it in good order, which things may be found in various treatises on electricity, I shall only observe with respect to the electrical machine in general, that its size should not be so small as it was thought sufficient some time ago, when the smallest machines were supposed to be sufficiently useful for the purpose. It is somewhat remarkable, that when a small power of electricity is to be used, large machines should be recommended; whereas, a short time ago, strong shocks were

were administered, and small electrical machines were used; but it must be considered that when shocks are given, very small electrical machines can charge a Leyden phial much stronger than required; but when the stream is used, which has lately been found to be far more efficacious, then the small machines are mostly useless. Probably the largest machines will not be found to afford a stream too strong for medical purposes; but the useful ones, which do not require a great labour to be put in motion, and may furnish a sufficiently dense stream, should have the glass globe or cylinder at least nine inches in diameter, which, with a proportionate conductor, may usually give sparks about three inches long. Whether the rubber of these machines stands upon a glass pillar or not, viz. whether it may be occasionally insulated or not, seems to be immaterial with respect to medical electricity: but as to have it situated upon a glass pillar is useful for electrical experiments in general, and perhaps it may be found hereafter, that negative electrization is beneficial in some disorders, a person

who is to choose a new electrical machine, may rather have the rubber fixed upon a glass pillar, than otherwise,

With such machines, the power of electricity should be so regulated, as to apply every degree of it with facility and readiness ; beginning with a stream issuing out of a metal point, next using a wooden point, then small sparks,—stronger sparks, and lastly small shocks. Every one of these methods may be increased or diminished considerably, by a proper management : thus, by turning the wheel of the machine swifter or slower, the stream of electric fluid may be regulated according as the circumstances may require. The sparks may also be made stronger or weaker, by taking them at a greater or less distance, and by turning the wheel swifter or slower ; and so of the rest.

It is impossible to prescribe the exact degree of electrization that must be used for various disorders ; for persons of different constitutions, although afflicted with the very same disease, require different

ferent degrees of electrization. Some persons are of so delicate and irritable constitution, that the smallest sparks give them as much pain as shocks do to others. On the contrary, some people can suffer pretty severe shocks without positive pain; and I have heard, though never saw any, of persons who were insensible of any electric power, even of considerably strong shocks.

In respect to this important point, the operator must be certainly instructed by experience; however, in the beginning, he may be assisted by the two following rules. First, he should begin to administer to his patients the very smallest degree of electric power, which he ought to continue for a few days, so as to observe whether it produces any good effect, which if it fails to do, he should then increase the strength of electricity; and so proceed gradually till he finds the effectual method, which he should follow without variation, till the patient is intirely cured. In short, the operator should always use the smallest degree of electric power, that is sufficient

for the purpose. A little practice will enable him to determine at once what degree of electricity is required for his patient, without any useless attempts. Secondly, the degree of electrization to be administered, should never exceed that, which the patient can conveniently suffer ; experience shewing, that when the application of any degree of electricity is very disagreeable to the patients, they very seldom mend.

The instruments which, besides the electrical machine and its prime conductor, are necessary for the administration of medical electricity, may be reduced to three; viz. an electric jar, with Mr. Lane's electrometer, an insulated chair, or an insulated stool, upon which a common chair may be occasionally set, and the *directors* *.

Those instruments are delineated in the annexed plate. Fig. 1. represents the

* Various other instruments useful in medical electricity, are described in divers books, but those mentioned above are sufficient to answer every required purpose.

electric jar, with Mr. Lane's electrometer, and the manner in which the shocks are sent through any particular part of the body. The surface of the jar, which is coated with tinfoil, should be about four inches in diameter, and six inches high, which is equal to about seventy-three square inches. The brass wire, which passes through the covering of the jar and touches the inside coating, has a brass ball, F, to which the electrometer F D E is fastened; and proceeding a little farther up, terminates in another brass ball B, which should be so high as to touch the prime conductor A, which is supposed to stand before the electrical machine. The electrometer consists in a glass stick F D, cemented to two brass caps F and D; from the latter of which a strong perpendicular brass wire proceeds, the extremity of which comes as high as the center of the ball B, and is furnished with an horizontal spring socket, through which the wire C E, having the brass ball C at one end, and the open ring E at the other, may be slid backwards and forwards, so as to set the brass ball C at any required distance from
the

the ball B. This distance, at most, needs not be greater than half an inch; hence the electrometer may be made very small. Sometimes small divisions are marked upon the wire C E, which serve to set the balls B and C at a given distance from one another, with more readiness and precision. Now suppose that the jar is set contiguous to the prime conductor, that is, with the ball B touching the conductor, that the ball C be set at one tenth of an inch distance from the ball B, and that by means of wire, a conducting communication be formed from E to the outside coating of the jar, as it is represented by the dotted line in the figure. In this case, if the electrical machine be put in motion, the jar will be charged, and when the charge is so high as the electric fluid accumulated within the jar can leap from the ball B to C, which we have supposed to be one tenth of an inch asunder, the discharge will happen, a spark appearing between the said balls, and the shock passes through the wire represented by the dotted line; for the part F D of the electrometer being of glass, generally covered with sealing

sealing wax, is impervious to electricity, consequently the electric fluid has no other way through which it can pass from the inside to the outside of the glass jar. When the shocks are to be given with this apparatus to any particular part of the body, for instance, to the arm, then, instead of the dotted line representing a wire, which must now be supposed as not existing in the figure, two slender and pliable wires, E L, I L, are to be fastened, one to the open ring E of the electrometer, and the other to the brass hook I of the stand H I, which communicates with the outside coating of the jar *. The other extremities of the said wires are fastened each to the brass wire L, and L of the directors K L, K L. Each of those instruments, justly called *directors*, consists of a knobbed brass wire L, which by means of a brass cap is cemented to the glass handle K. The operator holding

* If the jar has not the stand H I, the extremity I of the wire I L may be simply rested under, or may be tied round it. In short, it must be put in contact with the outside coating of the jar, in any convenient manner.

them

them by the extremity of the glass handle, brings their balls into contact with the extremities of that part of the body of the patient, through which he desires to send the shock. The management and convenience of this apparatus are easily comprehended by inspecting the figure; for when the machine is in motion, and the apparatus, &c. is situated as in the figure, the discharge of the jar must be evidently made through that part of the patient's arm which lies between the knobs of the directors; and the operator, whilst an assistant keeps the machine in motion, has nothing more to do, but to hold the knobs of the directors to the extremities of the arm, or to any other part of the body that is required to be thus electrified; always taking care that the two wires E L, I L, do not touch each other, because in that case, the shock will not pass through that part of the body which is required to be electrified. Thus any number of shocks, precisely of the same strength, may be given, without altering any part of the apparatus, or having any farther trouble; and when the

3 -

strength

strength of the shocks is required to be diminished or increased, it is only necessary to diminish or augment the distance between the balls B C, which is done by flipping the wire C E forwards or backwards through the spring socket that holds it.

It is almost superfluous to mention, that when shocks are administered, it is immaterial whether the patient stands upon the ground, upon the insulating stool, or in any other situation whatever. It is neither always necessary to remove the cloaths from the part that must be electrified, in order to let the knobs of the directors touch the skin; for except the coverings be too many and too thick, in which case part of them at least should be removed; the shocks will go through them very easily, especially if the knobs of the directors be pressed a little upon the part.

In the course of this essay we shall describe the strength of the shocks by the distance between the balls B and C of the electrometer, which we shall express by parts of an inch; supposing that the said
electrometer

electrometer is fixed upon such a jar as we have described above, viz. whose coated part, besides the bottom, may be equal to about 73 square inches, and whose glass is moderately thin ; for a larger or thicker jar with the same electrometer set at the same distances, will produce a much different effect, as it must be obvious to any person a little acquainted with the science of electricity.

Besides the directors mentioned above, there are other kinds of directors, which serve for throwing the stream of electric fluid, and other similar purposes. These are delineated in fig. 2. and 3. The director D in fig. 2. is much like those described above, excepting only that its wire is bent, and instead of having any ball, it terminates in a point, to which is affixed a piece of wood about one inch or one inch and a half long, pointed on one end, though not very sharp, and having a hole on the other. The operator should have by him various such wooden pieces, of different length and thickness, as E E, so as to shift them according as circumstances

stances may require; for sometimes the wooden pieces are too dry or too damp, or the machine is in bad order, &c. in which cases the stream of electric fluid would be either too strong or too weak, if the same wooden point was always used. The wood proper to make these pointed pieces should be rather of a soft kind, than hard, as box wood and *lignum vitæ* are.

In order to throw the electric fluid with this director, let a wire B, proceeding from the prime conductor A, fig. 2. be fastened to the wire of the director DE, which the operator must hold by the extremity of the glass handle, and must manage it so as to keep the wooden point at about one or two inches distance from the body of the patient*. This distance, however, must be regulated according to the constitution of the patient, the strength of the electrical machine, and other circumstances, which will be sug-

* When this or any other operation is performed, the electric jar, and in general any instrument not actually necessary, must be removed from the prime conductor, and even from the table if that is rather small.

gested by a little practice. The electric fluid issuing from the wooden point, has a power which is intermediate between that of the stream proceeding from a metal point, and the power of the sparks; but yet it is in general the most efficacious method of electrization, and therefore no pains should be spared in order to administer it in the best possible manner. This stream consists of a vast number of exceedingly small sparks, accompanied with a little wind, which gently irritates the part electrified, and gives a warmth which proves very agreeable to the patients. Sometimes when the machine is very powerful, and the wooden point is short or split, a very full and pungent spark issues from it, which is a very disagreeable accident, especially when the part electrified is very delicate. In order to avoid this inconvenience, the operator should first try the goodness of the point, before he begins the operation; which he may do by throwing the stream upon his own hand or face.

The

The above mentioned method of electrifying, gentle as it may appear, will nevertheless be found too strong for some persons, especially when used for open sores upon delicate parts; in which cases the wooden point must be removed, and the electric fluid must be simply thrown from the metal point of the director, which must now be kept at a greater distance than when the wooden piece was upon it. The electric fluid issuing out of this pointed wire of the director, occasions only a gentle wind upon the part towards which it is directed, and is far from being disagreeable even to the most delicate constitution.

It might be naturally suspected, that so gentle and nearly insensible a treatment could hardly be of any efficacy; but my reader may be assured, that to my certain knowledge, deduced from the practice of persons who have had long experience in this subject, this method of electrization, viz. the throwing the fluid with a metal point, has often mitigated pains, and cured obstinate and dangerous diseases, which could not be removed by any other remedy that was tried.

In general this treatment upon delicate nervous constitutions, is as efficacious as the other, viz. the throwing the fluid with a wooden point, is to ordinary constitutions. In several cases, especially of open sores, the electric fluid issuing out of a wooden point has constantly increased the pain, and even enlarged the sore; whereas the fluid issuing out of the metal point, has effectually diminished both.

The stream issuing out of a wooden point may be directed towards the eyes of the patient, without any apprehension of hurting him; in which case the operator should keep the eye-lid open with one hand. Indeed there might be some cases, though I seldom heard of any, in which this treatment may be thought to be too strong; then the metal point only may be used.

The stream issuing both out of the wooden and of the metal point, acts even through the cloaths, if they are not too thick; hence it may be used without incommoding the patient; but when it is
convenient

convenient to uncover the part that is to be electrified, it is much preferable to direct the fluid immediately upon the skin.

In this operation, the practitioner must mind to shift the point of the director about, so that the stream of electric fluid may be directed not only towards the affected part, but also to the places about it; alternately returning to the same place, and mostly insisting upon the part principally affected.

The patient in this operation may also stand in every situation that may happen to be more convenient to him.

When more proper instruments cannot be had, directors may be made by sticking large pins upon sticks of sealing wax, as it is represented at K, fig. 2.

Sometimes the wire B, which forms the communication between the prime conductor and the director, throws a considerable quantity of electric fluid into the air, which weakens the stream issuing

D 2 from

from the point. In order to remedy this inconvenience, I contrived a conducting wire, which being used by some of my friends, who practise medical electricity, has been found to answer very well the purpose of not dissipating the electric fluid. This conducting communication is formed of a silver, gold, or copper thread, such as are used for laces, which consist of a small lamina of metal twisted round a silk or linen thread. This metal thread, or two of them, I involve in a silk ribbon, which is coiled and sewed very tight upon it, leaving only a loop of the metallic thread uncovered at each extremity, one of which is to be fastened to the prime conductor, and the other to the wire of the director. See G H, fig. 2.

This sort of conducting communication, besides its preventing the dissipation of the electric fluid, is much more pliable than the stiff wire commonly used, and consequently may be managed more easily. It may be also used instead of the wires E L, I L, fig. 1. in the operation of giving shocks.

Two other directors different from the above mentioned, are delineated in fig. 3. Their use is to draw sparks from the inside of the ear in cases of deafness, pains, &c. and also from the teeth or other internal parts of the mouth. The director B H consists of a glass tube A B, about six inches long, and open at both ends ; whose diameter may be about one tenth of an inch, and the substance of the glass rather thick. A cork is thrust into one end of this tube, through which a wire passes; one extremity of which is cut blunt and smooth, and comes within one or two tenths of an inch shorter than the end B of the tube. The other extremity H of the wire, is furnished with a small metal ball.—Long pins, such as the ladies use for their hats, answer this purpose exceedingly well, when their points are filed off. The other director C D differs from that just described, in being only bent a little, for the convenience of adapting it more easily to some parts within the mouth.

When these directors are used, the patient must be situated upon an insulating

stool, viz. a stool furnished with glass feet, upon which a chair may be placed. Then a communication must be formed between the prime conductor and the body of the patient, by means of any sort of wire, especially that represented by G H, fig. 2. or by the patient only touching the prime conductor with his hand. In this case, it is easy to conceive that the patient becomes part of the prime conductor; and if any blunt conducting body is brought near him, when the machine is in action, a spark is obtained from him in the same manner as when the same blunt body is presented to the prime conductor itself. Every thing being thus far prepared, the operator holding the director A B or C D by its middle E or F with one of his hands, must bring the extremity B or D of the tube into contact, or nearly so, with the inside of the ear, mouth, &c. of the patient, as occasion may require; and must bring the knuckle of a finger of his other hand within a small distance of the small knob H or G of the director, which will extract small sparks from it, and at the same time the like sparks will happen between
the

the other extremity of the wire within the tube, and the part of the patient's body towards which the instrument is directed.

This is an excellent method to be practised in cases of deafnesses, pains in the ears, tooth-achs, swellings within the mouth, &c. especially because it may be increased or diminished at pleasure; viz. by drawing the wire G or H more or less from the extremity B or D of the tube, the strength of the sparks may be increased or diminished.

When sparks are required to be drawn from any part of the body, the patient must be situated upon an insulating stool, and must be connected with the prime conductor in the manner directed above; then the operator bringing the knuckle of one of his fingers, or the knob of a brass wire like K L, fig. 3, opposite to the affected part, will draw the sparks from it, which sparks will pass very easily through the cloaths, if they are not very thick. When the knobbed wire K L is used to draw sparks with, the ope-

rator must hold it by the extremity K, and present the knob L, &c. but it may also be used to draw the fluid silently, in which case the point K must be presented, and the knob L must be held by the hand of the operator. Here a wooden point may also be used, viz. by affixing it to the point K of the wire; which method answers as well as that of throwing the electric fluid by means of a wooden or metal point, with the director D of fig. 2. described in the preceding pages.

Sometimes it is required to take sparks from such parts as are covered with thick cloaths, and the patient is rather unwilling to uncover. In this case the best method is to situate the patient upon the insulating stool in contact with the prime conductor, then to bring the knob of a director like those delineated in fig. 1. in contact with the cloaths over the part required to be electrified; whilst the operator, holding the instrument by the extremity of its glass handle with one of his hands, brings the knuckle of one of his fingers on the knob

knob of the wire K L, fig. 3. pretty near the brass cap of the director, so as to draw strong sparks from it; the force of which will be felt very smartly upon the part of the patient's body; for at the same time sparks will happen there across the cloaths, viz. between the part of the body of the patient, and the knob of the director, which, for better security, should be pressed a little upon the cloaths.

In all those cases when the electric fluid, either in a stream or under the form of sparks and shocks, is to be forced across the cloaths, it is supposed that no metallic ornaments should be interposed, as gold or silver lace, long pins, and the like; for then the effects will vary considerably, according to the different circumstances.

There is another method of electrifying a diseased part of the body; which method cannot properly be called drawing sparks, though it comes very near to it. This manner of electrifying is effected in the following way: The patient is situated
upon

upon the insulating stool, and is made to communicate with the prime conductor; then a dry and warm flannel, either single or double, according as it may be occasionally thought more proper, is spread upon the naked part that must be electrified, and over this flannel the operator must put the knob L of the wire K L, fig. 3. quite into contact with the flannel, whilst he holds it by the other extremity K. Now when the machine is in action, the knob L of the wire must be shifted very quick and nimbly from place to place over the flannel; in which manner a vast number of exceedingly small sparks will be drawn across the flannel; which generally bring an agreeable warmth on the part, and prove very beneficial to the patient, at the same time that they do not cause any very disagreeable sensation. In cases of paralytic limbs, rheumatism, spreading pains, coldness of any particular part, &c. this treatment is of singular benefit. In the following pages we shall call it *The method of drawing sparks through a piece of flannel*, or simply, *to draw sparks through flannel*.

As for the insulating chair, it is almost needless to give any particular directions concerning its construction; it being nothing more than a common wooden chair set upon an insulating stool; or, as some persons choose to have it, the chair itself is furnished with glass instead of wooden legs, which answers equally well. It is requisite that no sharp metallic points be put upon this chair; and even its wooden ornaments should be rather blunt than sharp edged; for points and edges in general dissipate the electric fluid considerably, and consequently weaken the power of the machine. The glass feet should be at least eight inches high; and, that they may insulate the better, especially in damp weather, they should be covered with sealing-wax. In the construction of this chair, a place should be always provided, whereupon the patient may rest his feet; the want of which is very disagreeable, because it is absolutely necessary that the feet do not touch the floor.—When only a common chair is to be occasionally set upon an insulating stool, the latter should be made somewhat larger than the former,

former, so that part of it may project before the chair upon which the person to be electrified may rest his feet.

After the description of the instruments necessary for the administration of medical electricity, I shall collect together some practical rules, which may serve as guide to those practitioners, who have not yet been sufficiently instructed by their own experience.

General Rules for Practice.

I. It should be attentively observed, to employ the smallest force of electricity, that is sufficient to remove or to alleviate any disorder; thus the shocks should never be used when the cure may be effected by sparks; the sparks should be avoided when the required effect can be obtained by only drawing the fluid with a wooden point; and even this last treatment ought to be omitted, when the fluid drawn by means of a metal point, may be thought sufficient. The difficulty consists in distinguishing the proper strength of electric power,

power that is required for a given disorder, the sex and constitution of the patient being considered. In regard to this point, it is impossible to give any exact and invariable rules; the circumstances being of such a nature, and so various, that long experience, and a strict attention to every particular phenomenon, are the only means by which proper instructions may be received. The surest rule, as we observed above, that can be given relating to this particular, is to begin by the most gentle treatment; at least such, that, considering the constitution of the patient, may be thought rather weak than strong. When this gentle treatment has been found ineffectual for a few days, which is denoted by the disease not abating, and the application of electricity not causing any warmth, or other promising phenomenon, upon the part electrized; then the operator may gradually increase the force of electricity till he finds the proper degree of it.

II. In judging of cases proper to be electrified, experience shews, that in general, all kinds of obstructions, whether of motion, of circulation, or of secretion,
are

are very often removed or alleviated by electricity. The same may also be said of nervous disorders; both which include a great variety of diseases. The application of electricity has seldom intirely cured diseases of a long standing, although it generally relieves them. To persons afflicted with the venereal disease, or to pregnant women, electrization has been thought to be pernicious; but my reader may be assured, that even in those cases it may be used without fear, if it is judiciously managed. When pregnant women are to be electrified for any disorder, the shocks should be absolutely forbidden; and even when the other more gentle treatments are used, a constant attention should be given to any phenomenon that may appear in the course of the electrization; the method of which should be increased, diminished, or suspended, according as circumstances may indicate. As for the venereal disease, it will be shewn, in the course of this work, in what manner, and in which cases, electricity may be applied.

III. In

III. In cases of gathering tumors, the best method is to draw the fluid, by means of a wooden point, or, if that proves painful, by a metal point. Sparks in these cases, and also shocks, are often hurtful. In stiffnesses, paralyties, and rheumatism, small sparks, especially through a double flannel, and also very small shocks (at most of one tenth of an inch) may be used. Stronger shocks may be sometimes, though seldom, administered for a violent tooth-ach, and for some internal spasm of no long standing.

IV. When any limb of the body is deprived of motion, it must be observed, that the privation of motion is not always originated by a contraction of the muscles; but that it is often occasioned by a relaxation; thus, for instance, if the hand is bent inwardly, and the patient has no power of straightening it, the cause of it may be a weakness of the outward muscles, as well as a contraction of the inward ones. In such cases, as it is often difficult even for good anatomists to discover the real cause, the surest method is to
electrify

electrify not only those muscles which are supposed to be contracted, but also their antagonists ; for to electrify a sound muscle is by no means hurtful.

V. When the stream of electric fluid is thrown either with a wooden or metal point, the length of the operation should be from three to ten minutes : more or less, according as occasion may require. When shocks are administered, their greatest number should not exceed a dozen or fourteen, except when they are to be given to the whole body in different directions. The number of sparks, when they are used, may generally exceed the number of shocks mentioned above.

VI. Lastly, it may be of use to mention, that when children must be electrified upon the insulating chair, as it is difficult to let them stay without motion, the most convenient method is, to let another person sit in the insulating chair, and to hold the child whilst the operator is electrifying him.

Having thus comprised into a few general rules, the method of applying electricity with safety, we shall in the following part describe the particular treatment, which has been found more expeditious and beneficial, in disorders of various species; and shall lastly add some authentic cases, which will serve as examples for the generality of practitioners.

P A R T III.

Containing the particular method of administering Electricity for various Diseases, and the account of some authentic Cases.

THE account of a few successful cases in medical electricity, as well as in any other branch of physic, does by no means establish the reputation of the treatment, when a vast number of unsuccessful trials are concealed from the eyes of the public. The variety of temperaments observable in the human species, and the coincidence of circumstances, is such, that sometimes very obstinate disorders seem to be cured by very trifling applications. The physicians, however, justly neglect those kinds of treatments, because they have
actually

actually failed in great many cases seemingly of the same nature.

In order, therefore, to give a proper estimate of the efficacy of a remedy, it is necessary to shew the proportion between the successful, and the unsuccessful trials; without being amazed at one case, and neglecting many others.

Agreeably to this observation, the reader will find in the following pages, an estimate of the effects of electricity applied as a remedy for various disorders. This estimate has been deduced from the cases which are hitherto come to my notice, and is therefore likely to receive much alteration and amendment by better information, and future practice.

Rheumatic disorders, even of long standing, are relieved, and generally quite cured, by only drawing the electric fluid with a wooden point from the part, or by drawing sparks through flannel. The operation should be continued for about four

or five minutes, repeating it once or twice every day.

Deafness, except when it is occasioned by obliteration, or other improper configuration of the parts, is either intirely or partly cured by drawing the sparks from the ear with the glass-tube-director, or by drawing the fluid with a wooden point. Sometimes it is not improper to send exceedingly small shocks (for instance, of one-thirtieth of an inch) from one ear to the other. — It has been constantly observed, that whenever the ear is electrified, the discharge of the wax is considerably promoted.

The tooth-ache, occasioned by cold, rheumatism, or inflammation, is generally relieved by drawing the electric fluid with a point, immediately from the part, and also externally from the face. But when the body of the tooth is affected, electrization is of no use ; for it seldom or never relieves the disorder, and sometimes increases the pain to a prodigious degree.

Swellings in general, which do not contain any *matter*, are generally cured by drawing the electric fluid with a wooden point*. The operation should be continued for three or four minutes every day.

Inflammations of every sort are generally relieved by a very gentle electrization.

In inflammations of the eyes, the throwing of the electric fluid by means of a wooden point, is constantly attended with great benefit; the pain being quickly abated, and the inflammation being generally dissipated in a few days. In these cases, the eye of the patient must be kept open, and care should be taken not to bring the wooden point very near it, for fear of causing any spark. Sometimes it is sufficient to throw the fluid with a metal point; for in these cases, too great an irritation should be always avoided. It is not necessary to continue this operation for three or

* It is very remarkable, that in some cases of white swellings, quite cured by means of electricity, the bones and cartilages were in some measure disfigured.

four minutes without intermission; but after throwing the fluid for about half a minute, a short time may be allowed to the patient to rest and to wipe his tears, which generally flow very copiously; then the operation may be continued again for another half minute, and so on for four or five times every day.

The *gutta serena* has been often cured by electrization; but at the same time it must be confessed, that to my certain knowledge, electricity has proved ineffectual in many such cases, in which it was administered for a long time, and with all the possible attention. I do not know that ever any body was worsted by it. The best method of administering electricity in such cases, is first to draw the electric fluid with a wooden point for a short time, and then to send about half a dozen shocks of one-twentieth of an inch from the back and lower part of the head to the forehead, very little above the eye.

A remarkable disease of the eye was some time ago perfectly cured by electrization;
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it was an opacity of the vitreous humour of the eyes. This seems to be the only case of the kind, to which electricity was applied.

All the cases of *fistula lacrimalis*, as far as I am informed, that have been electrified by persons of ability for a sufficient time, have been intirely cured. The method generally practised, has been that of drawing the fluid with a wooden point, and to take very small sparks from the part. The operation may be continued for about three or four minutes every day. It is remarkable that in those cases, after curing the *fistula lacrimalis*, no other disease was occasioned by it, as blindness, inflammations, &c. by suppressing that discharge.

Palsies are seldom perfectly cured by means of electricity, especially when they are of long standing; but they are generally relieved to a certain degree. The method of electrifying in those cases, is to draw the fluid with the wooden point, and to draw sparks through flannel, or through

the usual coverings of the part, if they are not too thick. The operation may be continued for about five minutes *per* day.

Ulcers, or open sores of every kind, even of a long standing, are generally disposed to heal by electrization. The general effects are a diminution of the inflammation, and at first a promotion of the discharge of properly formed matter, which discharge gradually lessens, according as the limits of the sore contract, till it is quite cured. In these cases the gentlest electrization must be used, in order to avoid too great an irritation, which is generally hurtful. To draw or throw the fluid with a wooden or even with a metal point, for three or four minutes *per* day, is absolutely sufficient.

Cutaneous eruptions have been successfully treated with electrization; but in these cases it must be observed, that if the wooden point is kept too near the skin, so as to cause any considerable irritation, the eruption will be caused to spread more; but if the point be kept at about six inches distance, or farther, if the electrical machine

is

is very powerful, the eruptions will be gradually diminished, till they are quite cured. In this kind of disease, the immediate and general effect of the wooden point, is to occasion a warmth about the electrified part, which is always a sign that the electrization is rightly administered.

The application of electricity has perfectly cured various cases of *St. Vitus's Dance*, or of that disease which is commonly called so; for it is the opinion of some very learned physicians, that the real disease called *St. Vitus's Dance*, which formerly was more frequent than it is at present, is different from that which now goes under that name. In this disease, shocks of about one tenth of an inch may be sent through the body in various directions, and also sparks may be taken. But if this treatment proves very disagreeable to the patient, then the shocks must be lessened, and even omitted; instead of which, some other more gentle applications must be substituted.

Scrophulous tumors, when they are just beginning, are generally cured by drawing the electric fluid with a wooden or metal point from the part. This is one of those kinds of diseases in which the action of electricity requires particularly the aid of other medicines, in order to effect a cure more easily; for scrophulous affections generally accompany a great laxity of the habit, and a general cachexy, which must be obviated by proper remedies.

In *cancers*, the pains only are mostly alleviated by drawing the electric fluid with a wooden or metal point. I know of one case only, in which a most confirmed cancer of very long standing, on the breast of a woman, has been much reduced in size. It is remarkable, that this patient was so far relieved by drawing the fluid with a metal point from the part, that the excruciating pains she had suffered for many years, did almost entirely disappear; and also, that when the electric fluid was drawn by means of a wooden point, the pains did rather increase. This person is still under the application
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of electricity; and the cancer seems not unlikely to be perfectly cured, although contrary to the expectations even of the judicious physician who electrifies her, and who knows too well the nature of that dangerous disease.

Abscesses, when they are in their beginning, and in general whenever there is any tendency to form matter, electrizations disperse them. Lately, in a case in which matter was formed upon the hip, called the *lumbar abscess*, the disease was perfectly cured by means of electricity. The *sciatica* has also been often cured by it. In all such cases, the electric fluid must be sent through the part by means of two directors applied to opposite parts, and in immediate contact either with the skin, or with the coverings, when these are very thin. It is very remarkable, that the mere passage of the electric fluid in this manner, is generally felt by the patients afflicted with those disorders, nearly as much as a small shock is felt by a person in good health. Sometimes a few shocks have been also given, but it seems more

proper to omit them ; because sometimes, instead of dispersing, they rather accelerate the formation of matter.

In cases of *pulmonary inflammations*, when they are in the beginning, electrization has sometimes been beneficial ; but in confirmed diseases of the lungs, I do not know that it ever afforded any unquestionable benefit ; however, it seems that in such cases the power of electricity has been but seldom tried.

Nervous head-aches, even of a long standing, are generally cured by electrization. For this disease, the electric fluid must be thrown with a wooden, and sometimes even with a metal point, all round the head successively. Sometimes exceedingly small shocks have been administered ; but these can seldom be used, because the nerves of persons subject to this disease are so very irritable, that the shocks, the sparks, and sometimes even the throwing the electric fluid with a wooden point kept very near the head, throws them into convulsions.

The application of electricity has often been found beneficial in the *dropſy*, when juſt beginning, or rather in the tendency to a dropſy ; but it has never been of any uſe in advanced dropſies. In ſuch caſes, the electric fluid is ſent through the part, in various directions, by means of two directors, and ſparks are alſo drawn acroſs the flannel or the cloaths ; keeping the metal rod in contact with them, and ſhifting it continually from place to place. This operation ſhould be continued at leaſt ten minutes, and ſhould be repeated once or twice a day.—Perhaps in thoſe caſes, a ſimple electrization, (viz. to inſulate the patient, and to connect it with the prime conductor whiſt the machine is in action) continued for a conſiderable time, as an hour or two, would be more beneficial.

The *gout*, extraordinary as it may appear, has certainly been cured by means of electricity, in various inſtances. The pain has been generally mitigated, and ſometimes the diſeaſe has been removed ſo well as not to return again. In thoſe caſes, the electric fluid has been thrown
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by means of a wooden point, although sometimes, when the pain was too great, a metal point only has been used.

Agues very seldom fail of being cured by electricity, so that sometimes one electrization, or two, have been sufficient. The most effectual and sure method has been that of drawing sparks through flannel, or the cloaths, for about ten minutes, or a quarter of an hour. The patients may be electrified either at the time of the fit, or a short while before the time in which it is expected.

The suppression of the menses, which is a disease of the female sex, that often occasions the most disagreeable and alarming symptoms, is successfully and speedily cured by means of electricity, even when the disease is of long standing, and after that the most powerful medicines used for it have proved ineffectual. The cases of this sort, in which electrization has proved useless, are so few, and the successful ones so numerous, that the application of electricity for this disease, may

may be justly considered as an efficacious and certain remedy. Great attention and knowledge is required, in order to distinguish the arrest of the menses from a state of pregnancy. In the former, the application of electricity, as we observed above, is very beneficial; whereas in the latter, it may be attended with very disagreeable effects; it is therefore a matter of great importance to ascertain the real cause of the disease, before the electricity be applied in those cases. Pregnant women may be electrified for other diseases, but always using very gentle means, and directing the electric fluid through other parts of the body, distant from those subservient to generation. In the real suppression of the menses, small shocks, i. e. of about one-twentieth of an inch, may be sent through the pelvis; sparks may be taken through the cloaths from the parts adjacent to the seat of the disease; and also the electric fluid may be transmitted by applying the metallic or wooden extremities of two directors to the hips, in contact with the cloaths; part of which may be removed in case they are too thick.

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Those various applications of electricity should be regulated according to the constitution of the patient. The number of shocks may be about twelve or fourteen. The other applications may be continued for two or three minutes; repeating the operation every day. But either strong shocks or a stronger application of electricity, than the patient can conveniently bear, should be carefully avoided; for by those means, sometimes more than a sufficient discharge is occasioned, which is not easily cured. In cases of uterine hæmorrhages, I don't know that the application of electricity was ever beneficial, neither that it has been often tried.—Perhaps a very gentle electrization, as to keep the patient insulated and connected with the prime conductor, whilst the electrical machine is in action, may be of some benefit.

In respect to *unnatural discharges* and *fluxes* in general, it may be observed, that some discharges are quite unnatural or adventitious, as the fistula lacrimalis, and some species of the venereal disease; but

others are only increased natural discharges, such as the menses, perspiration, &c. Now the power of electricity, in general, has been found more beneficial for the first, than for the second sort of discharges, which are mostly increased by it.

In the *venereal disease* electrization has been generally forbidden; having mostly increased the pains, and other symptoms, rather than diminished them. Indeed, considering that any sort of stimulus has been found hurtful to persons afflicted with that disorder, it is no wonder that electricity has produced some bad effects, especially in the manner it was administered some time ago, viz. by giving strong shocks. However, it has been lately observed, that a very gentle application of electricity, as drawing the fluid by means of a wooden or metal point, is peculiarly beneficial in various cases of this kind, even when the disease has been of long standing. Having remarked above that tumors, when just beginning, are dispersed, and that unnatural discharges are gradually suppressed by a judicious electriza-

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tion ; it is superfluous to describe particularly those states of the venereal disease in which electricity may be applied ; it is only necessary to remind the operator to avoid any considerable stimulus in cases of this sort.

The application of electricity has been found also beneficial in other diseases besides those mentioned above ; but as the facts are not sufficiently numerous, so as to afford the deduction of any general rules, I have not thought proper to take any particular notice of them ; especially because the effects of electricity on the human body in various circumstances, have been already sufficiently considered under general and comprehensive heads.

We may lastly observe, that in many cases, the help of other remedies to be prescribed by the gentlemen of the faculty, is required to assist the action of electricity, which by itself would perhaps be useless ; and on the other hand, electrization may often be applied to assist

the action of other remedies, as of sudorifics, strengthening medicines, &c.

“ While I was writing some of the
 “ above cases,” says Mr. Becket, “ an
 “ observation or two occurred to me,
 “ which, though perhaps of no great con-
 “ sequence, may not be amiss to men-
 “ tion, as every particular effect of elec-
 “ tricity seems to be worthy of notice.

“ One circumstance attending some of
 “ the preceding cures, particularly that
 “ of the *paralytic*, related by Mr. Jones,
 “ was a fresh and copious discharge of the
 “ *blisters*, which had been previously ap-
 “ plied to the patients.—This, I think,
 “ seems to be a pretty general consequence
 “ of electrification ; at least, I have myself
 “ known many instances of it ; particu-
 “ larly in one gentleman, whom I elec-
 “ trified for a paralytic complaint, and
 “ who had a blister applied to the back
 “ part of his neck. He informed me,
 “ that, in the night after his being elec-
 “ trified the preceding day, he found a
 “ much more copious discharge from the
 F 2 “ blister

“ blister than at other times ; though the
 “ operation was no more than his stand-
 “ ing, for about a quarter of an hour, on
 “ the insulated stool, while sparks were
 “ drawn from the side of his face.
 “ From hence it appears not impossible,
 “ that, in some cases, blisters may be at-
 “ tended with peculiar benefit, during a
 “ course of electrical treatment ; in others,
 “ perhaps, it might be worth while to
 “ make use of electricity, merely to ob-
 “ tain a favourable discharge from the
 “ blisters.”

*Authentic physical cases, in which Electricity
 was administered.*

C A S E I.

The particulars of the following case were communicated to me by Mr. Partington.

Daniel Wiscoyl, aged thirty-six, of a strong robust constitution, was sent from the Westminster Dispensary, in Gerard-street, to Mr. Partington, in order to be electrified for a violent inflammation in

both his eyes. The account he gave of his disorder, was the following:—Several dark objects of different shapes and sizes, seemed at first to obstruct his sight. This was succeeded by an inflammation in both his eyes, which increased with such rapidity, that in a week's time he was brought to the degree of blindness that afflicted him till he was electrified. He was immediately recommended to the Westminster Dispensary, where every possible attention was paid to his misfortune by Mr. Ford, the surgeon of that place; but the obstinacy of the disorder was such, that every endeavour made towards the relief of this poor man, proved useless.—Blisters and leeches, besides the other usual means, were applied without any efficacy whatever.

About two months after the commencement of the inflammation, Mr. Ford recommended him to Mr. Partington; who, on examining him, found that the eyelids could not be opened without the help of the fingers, and that when opened, the coats of the eye appeared of an uniform red

F 3
colour.

colour. The sight of the right eye, which was the most affected, was so far impaired, that when it was turned towards a window, the eye-lids being forced open, he could perceive only a red glare of light like a wall; but the rest of the room seemed to be equally dark, so that he could not distinguish any object in it. With the left eye he could distinguish colours and the shapes of objects that were held to him, but in their sizes he was commonly mistaken. This disorder was accompanied with excruciating pains, shifting from one part to the other, but principally insisting on his temples, and sometimes darting to the back part of his head, or to the center of his eyes.

Mr. Partington began to electrify him the 21st of October, 1776; and three days after the inflammation began visibly to abate, and in a fortnight's time it was quite subsided; but the pupil of the eye was so nearly closed, that scarce any of it could be seen. He continued to be electrified every day for five weeks, and the pupil gradually dilated, till he attained a degree
of

of sight sufficient to distinguish objects on the other side of the way. The pains had now intirely left him, so that he omitted the use of electricity, and did not experience any farther inconvenience after it.

This remarkable cure was effected by throwing the stream of electric fluid with a metal, and with a wooden point. The first instrument used, which was contrived by the late Mr. Ferguson, consisted in a pointed brass wire, fastened by means of a cork at the smaller end of a conical glass, open at both ends, and passing through the axis of this conical or funnel-like glass, its point came within about half an inch of the larger aperture of the glass. This instrument being designed to throw the electric fluid upon the eye, was to be fixed so that the larger aperture of the glass surrounding the eye, kept its lids open, and the point of the wire was opposite to the pupil, and about half or one inch from it. With this instrument it was observed that a spark often proceeded from the point of the wire, which occa-

fioned an insufferable pain ; for which reason Mr. Partington, who spares no pains to advance this branch of phycic, thought of improving this instrument by fixing a wooden point upon the pointed wire, by which means, the former inconvenience was intirely removed, and the stream of electric fluid was rendered more efficacious, and more easily manageable.

This, as far as I am informed, was the first time that this most excellent method of throwing the electric fluid, viz. with a wooden point, was used.

N. B. The directors described in the preceding pages, the principal of which were contrived by Mr. Partington, answer every required purpose, much better than the above described instrument of Mr. Ferguson.

C A S E II.

The following case is related by Mr. Lovett, in his *Electricity rendered useful* :

“ Having observed the great efficacy of the electrical æther, in soon relieving most kinds

kinds of inflammations, I was inclined to think the same salutary effects would appear when applied to the St. Anthony's Fire ; but when a case of that sort offered, the inflammation was so great, that at first sight I almost despaired of success.

“ About the middle of the day I made the first trial, and before night the swelling was much abated, and in a few days quite cured.

“ The operation was simply drawing sparks with a finger, or an iron style, while the person was electrified on the insulating stool.”

C A S E III.

The following case is also related by Mr. Lovett :

Anne Thompson, in Little Fish-street, Worcester, was troubled with a fistula near the inner corner of her eye, which broke out, and healed, no less than seven times. The last time it healed, it continued well for some time ; after which it began with a small swelling, and continued growing larger,

larger, till it was as big as a filbert; when she was advised to try electricity. After the swelling was electrified, it soon decreased, till it was intirely dispersed; and has continued well for more than two years, without the least symptom of any return of the disorder.—The operation was simply drawing sparks from the part affected.”

C A S E IV.

The late Mr. Ferguson being at Bristol, was seized with a violent sore throat, so that he could not swallow any thing. Being willing to try the power of electricity, Mr. Adlam, of that city, performed the operation; which was merely drawing sparks from the throat. The electrization was repeated half an hour after, and was attended with so good and remarkable an effect, that in about one hour's time Mr. Ferguson could both eat and drink without pain,

C A S E V.

The following two cases are related by Mr. John Birch, Surgeon.

“ A young woman, at the age of twenty-two, desired my advice for a tumor on her thigh, which followed an unhappy accident she met with two years before. Her case was attended with many complicated symptoms, and, among them, a suppression of the menses, which had lasted seven months. I thought it right to relieve, if possible, this symptom, before I proceeded to perform the operation, which was necessary for the tumor.

“ For three successive days I passed some electric shocks through the region of the pelvis; and on the fourth, she was attacked with a violent pain in her side, which left her on applying the shocks to that part.—In about three hours it returned, and I was sent for. I repeated the shocks, and the pain again vanished. I visited her six hours after, when the
 pain

pain had begun to attack the side.—I passed a stronger shock, which removed it, and she slept well the whole night.—The next day, being the fifth, the menses appeared, and flowed gently for three days; but ceasing then, the pain of the side returned, and was so violent, that I was sent for in a hurry.—When I came to her, I found her in great agony; but being informed of the cause, I begged to make trial of electricity once more, which she readily consented to, as she had experienced such instantaneous relief before.—On its application, the pain ceased.—A very short time after, the flux came on, and continued two days.—I attended her for several weeks after, upon the former account, and had the pleasure to see her recover from all her complaints.”

C A S E VI.

“ I was sent for to a lady, who had been afflicted with painful ulcers on both her legs, for more than fifteen months.—They came after a lying-in, and had never healed. The legs were swelled,
but

but the ulcers had no malignant appearance.—She told me, that since her last miscarriage, which was then more than ten months, she had never been regular.—She attributed the pain and swelling of her legs to that cause; and upon enquiry, I found that she was sensible of an endeavour of nature to relieve herself at regular periods, and that the pain she suffered at those times, was alleviated by a bloody discharge from the ulcers.—I applied the proper dressings and bandages to the parts, and waited the approach of that period. In about ten days, a pain seized her back, and she began to complain of her legs: I then electrified her; and the next day she was taken out of order, and continued so the whole week.—The ulcers mended from that time, and were healed in three weeks afterwards.”

The reader may rest assured, that cases of this sort are so frequent, that perhaps, electricity may be considered as a sure, and indeed as the only sure remedy for the arrest of the menses.

C A S E

C A S E VII.

The following case is extracted from the
 LXVIIIth vol. of the Philosophical
 Transactions.

A cure of a muscular contraction by electricity. By Mr. MILES PARTINGTON, in
 a letter to WM. HENLY, F. R. S.

“ Great Russel-street, June 13, 1777.

“ DEAR SIR,

“ It is some time since, you informed
 “ me that you had mentioned to Sir John
 “ Pringle, Miss Lingfield’s cure by elec-
 “ tricity; that it excited his attention;
 “ and that it was his opinion, that the
 “ communication of it to the Royal So-
 “ ciety would be deemed important and
 “ useful. I hope you will not blame my
 “ delay in the compliance with your re-
 “ quest. I have waited for no other pur-
 “ pose, than to obtain the latest account
 “ of the permanency of those good ef-
 “ fects,

“fects, which she had then but recently
 “experienced, from our electrical experi-
 “ments upon her. Of these advantages
 “we have both had repeated confirma-
 “tion; and I may now, I believe, with
 “strict propriety, from the notes I made
 “for my own satisfaction, submit the fol-
 “lowing particulars of them, to the in-
 “spection of whomsoever your judgment
 “shall direct, or to appropriate them to
 “any other purpose you please. As you
 “were present when I first waited on this
 “unhappy young lady, you will recollect
 “the condition in which we found her.
 “Her head was drawn down over her
 “right shoulder; the back part of it was
 “twisted so far round, that her face
 “turned obliquely towards the opposite
 “side, by which deformity she was dis-
 “abled from seeing her feet, or the steps,
 “as she came down stairs. The *sterno-*
 “*mostoideus* muscle was in a state of con-
 “traction and rigidity. She had no ma-
 “terial pain on this side of her neck;
 “but, owing to the extreme tension of
 “the teguments of the left side, she had
 “a pain

“ a pain continually, and often it was very
 “ violent, particularly in sudden changes
 “ of the weather. Her pulse was weak,
 “ quick, and irregular. She was subject
 “ to a great irritability; had frequently
 “ a little fever, which came on of an
 “ evening, and left her before morning;
 “ her spirits were generally exceedingly
 “ oppressed; and at times she was slightly
 “ paralytic.

“ She dated the origin of her disorder
 “ at something more than two years
 “ from that period. She was suddenly
 “ seized, going out of a warm room into
 “ the cold air, with a pain upon the back
 “ of her head, which admitted of small
 “ abatement for some months, contracting
 “ gradually the muscles to the melan-
 “ choly deformity we then beheld; and
 “ notwithstanding every prudent means
 “ had been used to subdue it, and she
 “ strictly adhered to every article pre-
 “ scribed to her by the faculty, she was
 “ sensible of little variation since, and
 “ that rather on the unfavourable side.

“ I urged

“ I urged her to make a trial of elec-
 “ tricity. She was willing while she
 “ was in London to try the experiment;
 “ and though the weather was remark-
 “ ably tempestuous, she came to me the
 “ first tolerable day, and was electrified
 “ the first time, February 18, 1777.

“ I sat her in an insulated chair, and
 “ connecting it by a chain to the prime
 “ conductor of a large electrical machine,
 “ I drew strong sparks from the parts af-
 “ fected, for about four minutes, which
 “ brought on a very profuse perspiration
 “ (a circumstance she had been unaccus-
 “ tomed to) which seemed to relax the
 “ *moſtoideus* muscle to a considerable de-
 “ gree; but as the sparks gave her a good
 “ deal of pain, I desisted from drawing
 “ them, and only subjected her a few
 “ minutes longer to the admission of the
 “ fluid, which passed off without inter-
 “ ruption from the pores of her skin and
 “ adjacent parts. The next time she
 “ came to me, was the 24th of the same
 “ month. As she had been in the after-
 “ noon of the first day's experiment, a

“ good deal disordered, I changed the
 “ mode of conducting, and sat her in a
 “ common dining chair, while I dropped,
 “ for five minutes, by the means of a
 “ large discharging rod with a glass
 “ handle, very strong sparks upon the
 “ *moſtoideus* muscle, from its double ori-
 “ gin at the *ſternum* and *clavicula* to its
 “ infertion at the back of the head. She
 “ bore this better than before, and the
 “ ſame good effect followed in a greater
 “ degree, and without any of the ſubſe-
 “ quent inconveniences. I ſaw her the
 “ third time on the 27th. She aſſured
 “ me ſhe had eſcaped her feveriſh ſymp-
 “ toms on an evening, and that her ſpi-
 “ rits were raiſed by the proſpect of
 “ getting well; that ſince the laſt time
 “ I electrified her, ſhe had more freedom
 “ in the motion of her head, than ſhe had
 “ ever experienced ſince the firſt attack of
 “ her diſorder. I perſiſted in electrifying
 “ her after the ſame manner, March 3d,
 “ 5th, 6th, 7th, and 9th; from each time
 “ ſhe gained ſome advantage, and her fe-
 “ veriſh tendency and nervous irritability
 “ went off entirely.

“ The

“ The weather now setting in very un-
 “ favourable, and fearful of losing the ad-
 “ vantages we had happily reaped from
 “ our early efforts, I requested the favour
 “ of you, as the next-door neighbour, to
 “ electrify her every evening, while she
 “ was in town, and she might, if any al-
 “ teration took place, see me occasionally.
 “ Fortunately for her, you accepted the
 “ proposal; and to your judgment and
 “ caution in the conduct of it, for the
 “ next fortnight (three evenings only ex-
 “ cepted) you brought about the happy
 “ event; and have received her testimony
 “ of gratitude, for relieving her from a
 “ condition, under which life would not
 “ be desirable, to a comfortable association
 “ with her family and friends.

“ I am, &c.”

“ The method I pursued was, to place
 the lady upon a stool with glass legs, and to
 draw strong sparks, for at least ten mi-
 nutes, from the muscles on both sides of
 her neck. Besides this, I generally gave

G 2

her

her two shocks, from a bottle, containing fifteen square inches of coated surface, fully charged, through her neck and one of her arms, crossing the neck in different directions. This treatment she submitted to with a proper resolution; and it gave me sincere pleasure to find it attended with the desired success.

W. HENLY."

C A S E VIII.

The following case is extracted from the sixteenth vol. of the Philosophical Transactions.

An account of a cure of the St. Vitus's Dance, by electricity. In a letter from ANTHONY FOTHERGILL, M. D. F. R. S. at Northampton, to W. HENLY, F. R. S.

Northampton, Oct. 28, 1778.

S I R,

Agreeable to my promise, I now proceed to give you some account of a recent cure performed by electricity, which will, I think, afford you much pleasure.

Ann

Ann Agutter, a girl of ten years of age, of a pale emaciated habit, was admitted an out-patient at the Northampton Hospital on the 6th of June last. From her father's account it appeared (for she was speechless, and with difficulty supported from falling by two assistants) that she had for six weeks laboured under violent convulsive motions, which affected the whole frame, from which she had very short intermissions, except during sleep; that the disease had not only impaired her memory and intellectual faculties, but of late had deprived her of the use of speech.

Volatile and fetid medicines were now recommended, and the warm bath every other night, but with no better success, except that the nights which had been restless, became somewhat more composed. Blisters and anti-spasmodics were directed, and particularly the flowers of zinc, which were continued till the beginning of July, but without the least abatement of the symptoms; when her father growing impatient of fruitless attendance at the hospital, I recommended, as a dernier re-

G 3

fort,

fort, a trial of electricity, under the management of the Rev. Mr. UNDERWOOD, an ingenious electrician. After this I heard no more of her till the first of August, when her father came to inform me that his daughter was well, and desired she might have her discharge. To which, after expressing my doubts of the cure, I consented; but should not have been perfectly convinced of it, had I not received afterwards a full confirmation of it from Mr. Underwood, dated September 16; an extract from whose letter I will now give you in his own words.

“ I have long expected the pleasure of
 “ seeing you, that I might inform you
 “ how I proceeded in the cure of the poor
 “ girl. As the case was particular, I
 “ have been very minute, and wish you
 “ may find something in it that may be
 “ useful to others. If you think it pro-
 “ per, I beg you will state the case medi-
 “ cally, and make it as public as you
 “ please.

“ July 5. On the glass-footed stool
 “ for thirty minutes : sparks were drawn
 “ from the arms, neck, and head, which
 “ caused a considerable perspiration, and
 “ a rash appeared in her forehead. She
 “ then received shocks through her hands,
 “ arms, breasts, and back ; and from this
 “ time the symptoms abated, her arms
 “ beginning to recover their uses *.

“ July 13. On the glass-footed stool
 “ forty-five minutes : received strong
 “ shocks through her legs and feet,
 “ which from that time began to reco-
 “ ver their wonted uses ; also four strong
 “ shocks through the jaws, soon after
 “ which her speech returned.

“ July 23. On the glass-footed stool for
 “ the space of one hour : sparks were
 “ drawn from her arms, legs, head, and
 “ breast, which for the first time she very
 “ sensibly felt ; also two shocks through
 “ the spine. She could now walk alone ;
 “ her countenance became more florid,
 “ and all her faculties seemed wonderfully

* The coated bottle held near a quart.

“ strengthened ; and from this time she
 “ continued mending to a state of perfect
 “ health.

“ Every time she was electrified posi-
 “ tively, her pulse quickened to a great
 “ degree, and an eruption, much like the
 “ itch, appeared in all her joints.”

Thus far Mr. Underwood. To complete the history of this singular case, I this day (Oct. 28) rode several miles, on my return from the country, to visit her ; and had the satisfaction to find her in good health, and the above account verified in every particular ; with this addition, that at the beginning of the disease, she had but slight twitchings, attended with running, staggering, and a variety of involuntary gesticulations, which distinguish the St. Vitus's Dance ; and that these symptoms were afterwards succeeded by convulsions, which rendered it difficult for two assistants to keep her in bed, and which soon deprived her of speech and the use of her limbs. The eruptions which appeared on the parts electrified soon receded,

ceded, without producing any return of the symptoms, and therefore could not be called critical, but merely the effect of the electrical stimulus. Having given her parents some general directions as to her regimen, &c. I took my leave, with a strong injunction to make me acquainted, in case she should happen to relapse. Before I conclude, it may not be improper to observe, that some time ago, I was fortunate enough to cure a boy who had long had the St. Vitus's Dance (though in a much less degree) by electricity. A violent convulsive disease, somewhat similar to the above, though, if I recollect right, not attended with the *aphonia*, was successfully treated in the same way by Dr. Watson, and is recorded in the Philosophical Transactions. May we not then conclude, that these facts alone, and more might perhaps be produced, are sufficient to intitle electricity to a distinguished place in the class of anti-spasmodics?

I am, &c.

C A S E

C A S E IX.

In my Treatise on Electricity, published some time ago, I related only two cases of medical electricity; one of which was attended with bad, and the other with very good effects. I think it proper to subjoin them here.

The following case was related by Dr. Hart of Shrewsbury. See the Philosophical Transactions, Vol. XLVIII.

A girl, aged about sixteen, whose right arm was paralytic, being electrified the second time, became intirely paralytic, and remained in that state for about a fortnight; then the superadded paralysis was removed, by means of some medicines; but the arm which was before paralytic, remained so. It should be also added, that this arm was very much wasted in comparison to the other. Notwithstanding the first bad accident, it was resolved to make another trial of electricity. But
after

after using this treatment for three or four days, she became again universally paralytic, and even lost her voice, and could swallow with difficulty. This second accident plainly shewed the bad effects of electricity in that case, and the girl, although afterwards relieved of her additional paralysis, remained in the same state she was before the use of electricity.

In this case, it is suspected that electricity was improperly managed ; at that time being usual to give strong shocks, which perhaps were pernicious in the above-mentioned case.

C A S E X.

The following case was performed under the direction of the learned Dr. Wm. Watson, F. R. S.

A girl belonging to the foundling hospital, aged about seven years, being first seized with a disorder occasioned by the worms, was at last, by an universal rigidity of the
muscles,

muscles, reduced in such a state, that her body seemed rather dead than alive. After that other medicines had been ineffectually administered for about one month, she was at last electrified intermittedly for about two months, after which time she was so far recovered, that she could, without pain, exercise every muscle of her body, and perform every action as well as before she had the distemper.

The intelligent reader must have undoubtedly remarked that in some of the above cases, the electrization administered was rather strong, and different from the general rules given previous to the narration of the cases. But it must be observed, that some of the above cases happened before the principal methods of electrifying, which are now used by the best practitioners, were introduced.—Perhaps, in similar cases, the same salutary event might be produced by a more gentle electrization.

A P P E N D I X.

WHILE part of this Work was under the press, it was requested by some of my friends, to add a few Experiments to be performed with the electrical machine, which might shew some effects of the electric fluid upon the human body. Indeed, to exhibit experiments of this kind upon artificial machines only, without the human body itself, when duly considered, can hardly be supposed to afford much light; because the difference between the body of an animal, and the machines which can be made most similarly to it, is so great, as to produce effects much different, although one would hardly suspect any difference in the mechanism. The effects therefore of the electric fluid upon the human body, must be absolutely

investigated by experiments upon it, and in some measure also by experiments upon other animals. However, to satisfy the curiosity of those gentlemen, I shall add in this appendix, a few experiments, which shew some effects analogous to those produced by electricity upon the human body.—They may divert a leisure hour, and perhaps may open the way to farther investigations.

EXPERIMENT I.

Let a small bucket of metal, full of water, be suspended from the prime conductor, and put in it a small syphon, having a very narrow aperture, from which the water will just drop into a basin put at some distance under it. This syphon is best made of a piece of slender cane.—Fig. 4. represents the apparatus for this experiment: A is the prime conductor, B is the metal bucket, generally made of tin, C the syphon, and D the basin, into which the water drops from the syphon. In this disposition, if the winch of the machine be turned, the water, which,
when

when not electrified, only dropped from the extremity of the syphon, will now run in a full stream, which will even be subdivided into other smaller streams; and if the experiment be made in the dark, it will appear beautifully illuminated.

This experiment may shew that perspiration is promoted by electricity; but it must be observed, that in general, when electricity is communicated to insulated vessels, containing water that is actually running from a pipe, the stream will not be always accelerated, but will nearly observe the following laws :

“ 1. The electrified stream, though it
 “ divides and carries the liquid further,
 “ is neither sensibly accelerated nor re-
 “ tarded, when the pipe through which
 “ it issues, is not less than a line in dia-
 “ meter.

“ 2. Under this diameter, if the tube
 “ is wide enough to let the liquid run in a
 “ continued stream, electricity accelerates
 “ it a little, but less than a person would
 “ imagine,

“ imagine, if he judged by the number of
 “ jets which are formed, and by the dis-
 “ tance to which they go.

“ 3. If the tube be a capillary one,
 “ from which the water only drops natu-
 “ rally, the electrified jet not only be-
 “ comes a continued stream, but is also
 “ considerably accelerated; and the smaller
 “ the capillary tube is, the greater in
 “ proportion is the acceleration.

“ 4. So great is the effect of the elec-
 “ tric virtue, that it drives the water in
 “ a constant stream out of a very small ca-
 “ pillary tube, out of which it had not
 “ before been able even to drop.”

In this experiment, whether the elec-
 tricity is positive or negative, viz. whe-
 ther the bucket with the syphon in it,
 is suspended to the prime conductor, or
 to the rubber of an ordinary electrical
 machine, the effect is always the same,
 provided the electrization is equally strong.
 Indeed, if we consider the principal elec-
 trical phenomena, as the attraction, repul-
 sion,

sion, promotion of evaporation, which is certainly a consequence of the repulsion communicated to the particles of bodies actually evaporating; and in short, considering those phenomena, which are produced by electricity upon the human body, and upon the bodies of other animals, we could hardly believe that negative electrization retards the pulse, contrary to the effect of positive electrization, as it has been lately pretended, even supposing that the direct experiment had not been actually tried.

EXPERIMENT II.

To promote the evaporation of fluids, by means of electricity.

Take two equal pewter plates, and pour in each of them an equal quantity of water, just enough to cover their bottoms, and with the help of a pair of scales let them be made equal in weight. This done, put one of the plates upon an insulated stool, communicating with the prime conductor of the electrical machine, and situate the other plate in some other part of the room, where it may be in an equal degree of heat, and equally exposed to the

air as the other plate, but only out of the influence of electricity. Let now the machine be put in action, so as to keep the prime conductor and the plate connected with it, strongly electrified for about half an hour or longer. Then stop the machine, and weigh both the plates ; it will be found, that the plate which has been electrified is the lighter : hence it is plain, that the electrization has promoted the evaporation of the water contained in it.

The same experiment may also be made with fruit, with animals, with plants, and in short, with any thing that is actually evaporating ; but in some such cases, the electrization should be continued much longer ; and also other circumstances ought to be taken into account, in order to render the effect of electricity both sensible and certain. This experiment is also attended with the same effect, whether the electrization is positive or negative ; hence we have another reason to disbelieve that negative electrization produces any effects upon the human body, different from the positive. One Mr. Koestlin, who a few years ago published a dissertation on the effects

effects of electricity upon some organic bodies, pretended to have found, that both animal and vegetable life were retarded by negative electrification ; but I do not know whether the experiment was ever repeated by any body else. The oddity and diversity of effects arising from experiments apparently similar, is such, that no person conversant with experimental philosophy, should positively affirm any new natural law, that is indicated by a few facts, which are mostly of a dubious nature ; especially when many other considerations seem to shew the improbability of the assertion.

EXPERIMENT III.

To shew that the fluids of the human body are better conductors of electricity than water.

Take a glass tube about one-fortieth of an inch in diameter, and nearly six inches long, or rather two such tubes exactly equal in length and diameter, and holding one of them with one extremity in water, let it be filled with that fluid. The water will soon fill the tube in virtue of the capillary attraction, especially if the tube be held inclined to the surface of the water. After the same manner let the other tube

be filled with blood, or some other fluid of the human body. Now let an electric jar be charged, and the circuit through which the jar is to be discharged, let it be formed of one of these tubes ; to the extremities of which slender wires may be fitted so as just to touch the fluid contained in it, and also of the arms of a person that is desirous of trying the experiment. In this manner, if the discharge of the jar be made several times, alternately changing the glass tube, viz. using once that filled with water, then the other filled with blood, and so on ; it will be found that the shock is felt more sensibly when the glass tube filled with any fluid of the human body forms part of the circuit, than when the tube filled with water is used.

The person who tries this experiment, need not be afraid of the shocks, because their force is much weakened by going through the fluid contained in the glass tube. Besides, the strength of the shocks should not be greater than they may be just felt ; it is only necessary to charge the jar always equally high, which is easily done

done by means of Mr. Lane's electrometer, described in the preceding pages.

After the like manner the degree of conducting power of various substances may be ascertained. Thus it may be observed, that sea-water conducts better than fresh water, and that common fresh water conducts better than distilled water. The conducting power of some powders may be also tried in this manner.

EXPERIMENT IV.

To break small glass tubes by means of an electric shock.

Let some glass tubes be drawn with the help of a blow-pipe, nearly in the shape represented by E F, G H, fig. 4. viz. narrow in the middle and larger towards their extremities. The diameter of the middle part should not exceed one-twentieth part of an inch. Fill one of these tubes with water, after the manner described in the preceding experiment, and insert two slender wires through both apertures, the extremity of which within the tube, should come within about one

tenth of an inch of each other.—This done, let the discharge of a small electric jar be made through this tube, viz. by connecting the ring of the wire E with the outside of the jar, and the ring of the wire F with the inside of the said jar, that is, with the ring E of the electrometer, fig. 1. and the tube will be broke with considerable violence. The same effect is produced when the tube is filled with any other liquor instead of water.

If the extremities of the wires within the tube are put so far from each other, as to exceed the distance at which the charge of the jar can leap in the form of a spark, then the glass tubes will not be broke,

By this experiment we can hardly deduce any instruction relative to the sensation of the shock perceived by a person, who forms the circuit in the discharge of an electric jar; for we learn by the experiment, that except any spark happens within the water, the finest and brittlest tube is not broke, and therefore we may conclude, that the concussion given to the tube by the shock, when the extremities

tremities of the wires within it are considerably far from each other, is very little, if at all sensible.—Farther, it seems plain, that if instead of one tube, the discharge of the jar was made through one hundred or one thousand tubes, the impulse of the shock would be proportionably lessened; and indeed we can hardly form any idea of the smallness of its power in that case. How happens it then that a very small shock sent across the arms of a man, which shock, we may reasonably suppose, does not occasion any spark within the vessels of the body, is sensibly felt, and produces an involuntary motion, when it passes through innumerable vessels filled with fluids, which are far better conductors than water?

The substance of the vessels of the human body is certainly a less good conductor than the fluids contained in those vessels; but it can hardly be suspected, that the electric fluid occasions the involuntary motion, &c. by going through that substance rather than through the fluids, which are much better conductors. Perhaps that sudden involuntary motion is

produced by the electric fluid acting upon the nerves. But it seems that, independent of the already known parts of the human body, there is some other principle that accompanies the life of an animal, which is in a certain manner a conductor of electricity, and whose action ceases as soon as the animal becomes extinct. It has been remarked in several instances, that if an electric shock passes through a given part of a living animal, the same shock, after that the animal is dead, will be visibly transmitted over the surface of the same part, but not through it. This remarkable experiment may be easily tried with a mouse, in the following manner. Charge a large electric jar or a small battery, and by means of two directors, like those delineated in fig. 1. send the full charge of it from the head to the back of a mouse. The animal, if the shock is sufficiently strong, will be instantly deprived of life. Immediately after, charge the jar again, and discharging it in the same manner through the same mouse, after death; it will be often found that the shock will no longer go through the body, but will pass over it in a visible luminous track; hence

we must necessarily conclude, that something which assisted the passage of the shock through the body of the mouse whilst living, is now either lost or become inactive.

EXPERIMENT V.

To crystallize oil of tartar by means of electric sparks.

Take a glass tube about four inches long, and about one quarter of an inch in diameter, open at both ends, and moisten the inside of it with oil of tartar per deliquium; then adapt two corks to the extremities of this tube, and introduce a wire through each of them. The extremities of these wires within the tube should be about three quarters or one inch from one another. This done, connect one of the wires with the outside coating of a pretty large electric jar, and the other wire with the above described electrometer; then let the jar be discharged several times through the tube; and it will be often found, that the oil of tartar upon the inside surface of the tube, gives manifest signs of crystallization. Now by experiments similar to this, some ingenious persons have pretended to shew, that the electric fluid

contains

contains an acid, which combining with the oil of tartar, neutralizes it, and occasions the crystallization.—It has even been said, that the phenomena of electricity are the effects of two principles, viz. an acid, which constitutes the positive, and an alkali, which constitutes the negative electricity. It would be useless to endeavour to refute such an hypothesis, when a very little acquaintance with the subject is sufficient to manifest its absurdity. It is only necessary to observe, that in almost every combustion, there is generated a quantity of an elastic fluid, commonly known under the name of *fixed air*; which elastic fluid is an acid, and crystallizes with oil of tartar. Farther, that the electric fluid when proceeding with violence from the surfaces of conductors, does always burn or calcine a very small portion of these conductors; hence the crystallization of the oil of tartar, when it happens in the above-mentioned experiment, which is very seldom the case, and then in a very slight degree, must certainly be owing to the fixed air generated, and not to the electric fluid itself, considering it is an acid.

In a similar manner it is shewn that the electric sparks repeatedly taken in a quantity of common air, contaminate it, and precipitate the lime in the lime-water, that is exposed to it; yet the phlogiston probably proceeds from those conductors, through which the electric fluid passes, and consequently does not shew that the electric fluid itself is phlogiston. This supposition, that the phlogiston, which contaminates the air, &c. proceeds from the conductors, through which the electric fluid passes, I published in my *Treatise on electricity*; but it has since been rendered much more probable by an observation of the learned Mr. Fontana. This gentleman observed, that when the wires, through which the sparks were taken in a quantity of air, were of pure silver, which is reckoned a pure metal, the air was phlogisticated with great difficulty, and in a very small degree; but when brass or iron wires were used, the phlogistication was effected much more easily. Now this observation not only shews that the phlogiston proceeds from the wires, but also confirms Father Beccaria's observation, viz. that the electric fluid conducts

certain

certain substances along with itself in its passage. However, these substances seem to be neither essential to the passage of the electric fluid, nor always the same.

Considering these effects of the electric fluid, it might perhaps be suspected, that the acid or the phlogiston, which accompany that fluid, however they may be originated, could possibly be of some use in medical electricity. But here two things must be remarked; first, that the quantity of that acid or phlogiston is exceedingly small; and secondly, that all the experiments hitherto made, shew that they penetrate a very short way beyond the surface of consistent bodies.

Father Beccaria treating of the medical uses to which electricity might be applied; The only point, says he, about which I have some suspicion, is whether the sparks drawn immediately from any medicine may determine some particles of those medicines into the skin of the person that takes those sparks. It being a constant fact, that the sparks separate from bodies some conducting effluvia, and im-
pel

pel them upon the surfaces of those bodies between which they leap. I find that Dr. Franklin has made many shocks pass through his own body, from an electric jar filled with a strong purgative ; but it was attended with no particular phenomenon. I do not know if he touched a wire communicating with the inside of the jar, in which case the experiment would afford no proof against my suspicion ; or if he discharged the jar by touching immediately the surface of the purgative ; and even then the experiment could not afford any general conclusion ; it being possible that the skin does not admit that particular sort of medicine, in the same manner as it does not admit the salt of seawater. I am ignorant of any particular substance, but only inquire if there may be some substance, whose vapours might be insinuated through the integuments of the human body by means of electric sparks. The following is an experiment which bears some analogy to it. I put a large drop of mercury in the bottom of a china cup, one side of which communicates with the prime conductor. On the opposite side I fix with pincers two pieces

of gold, equally distant from the drop of mercury ; and constantly touching one of them, I oblige the sparks to pass from it to the drop of mercury, and after taking many sparks, I find that the piece of gold which I have touched, has acquired a bluish colour on its edge where the sparks touched. But no mark of any particular colour is perceived upon the other piece of gold.

Thus that elegant electrician supposes, that possibly there may be found some substance, the particles of which the electric sparks may force into the skin of the human body. It is obvious to observe, that all the experiments hitherto published, and the considerations deduced from them, seem to shew that the quantity of the medicine thus possible to be introduced into the human body by means of electric sparks, would be so exceedingly small, as to produce no sensible effect in cases of diseases.

HAVING

HAVING collected together all the observations which seemed worthy of the attention of the public, in respect to medical electricity, and having arranged them in that order which seemed more perspicuous and natural ; I shall lastly recapitulate into a few words, the properties of electricity upon the human body, both in a sound and in a diseased state ; with which I shall conclude this essay.

1. Simple electrization, whether positive or negative, generally increases the ordinary number of pulsation of about one sixth. This effect is pretty constant with healthy people, and is also often produced in diseased persons. It constantly increases the natural perspiration ; and, in general, promotes glandular secretions.

2. Electrization has been found to be beneficial in various diseases, and it has very seldom produced any bad effects. Indeed it may be said, that it has *never* produced any bad effects, when judiciously managed.

3. The

3. The diseases in which the application of electricity has been mostly beneficial, are those arising from obstructions and nervous affections. On the contrary, it has proved less beneficial in fluxes or increased natural discharges; but those unnatural discharges which are quite adventitious, as the *fistula lacrymalis*, &c. are generally cured by it.

4. Lastly, it has been observed, that the applications of different degrees of electric power, are attended with very different effects, viz. that a moderate electrization has perfectly cured several diseases, whereas a stronger electrization constantly increased them. But the proper degree of electrization must be learned from the effects it produces daily, and from the feeling of the persons electrified.

F I N I S.

Fig 1-

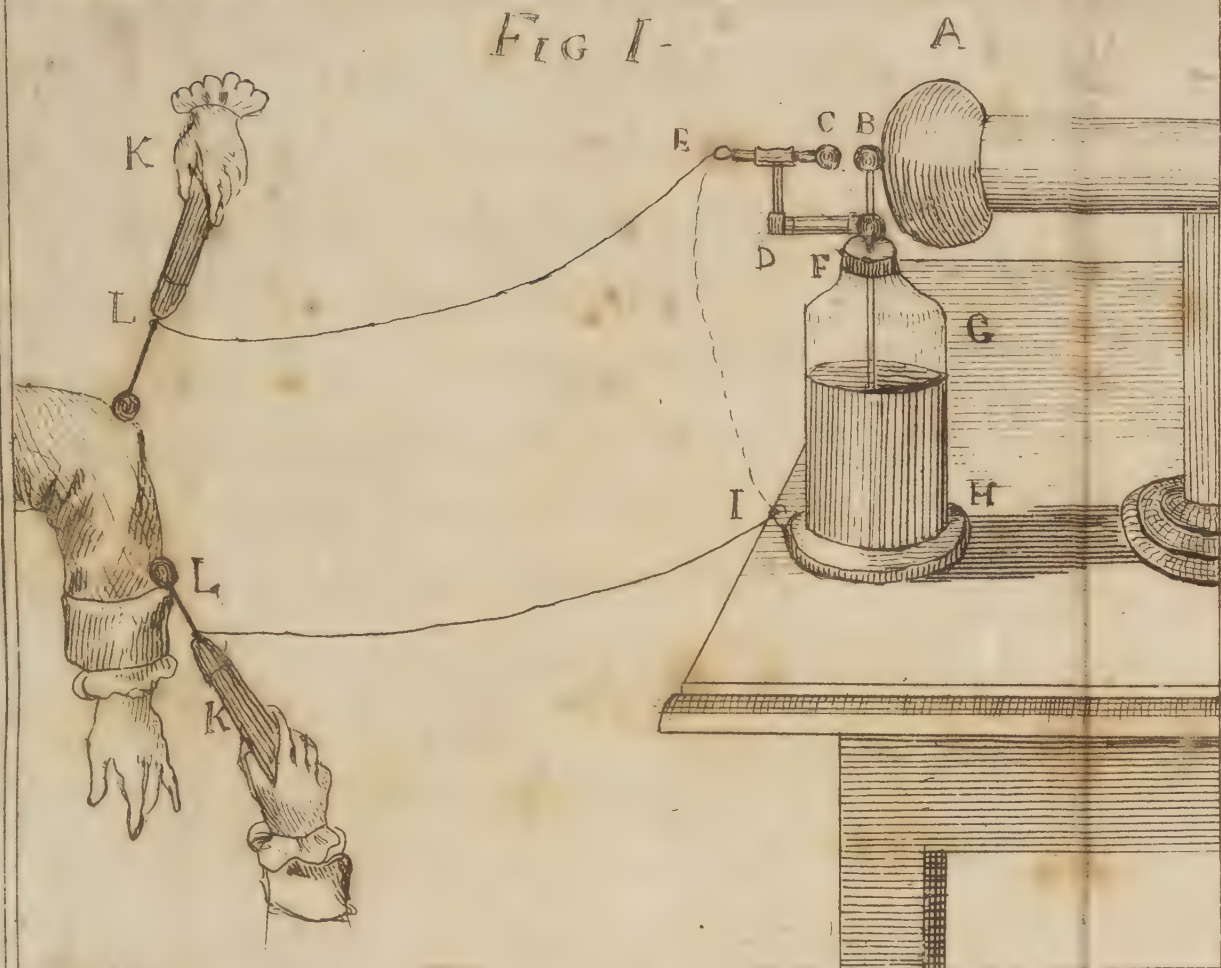


Fig 2-

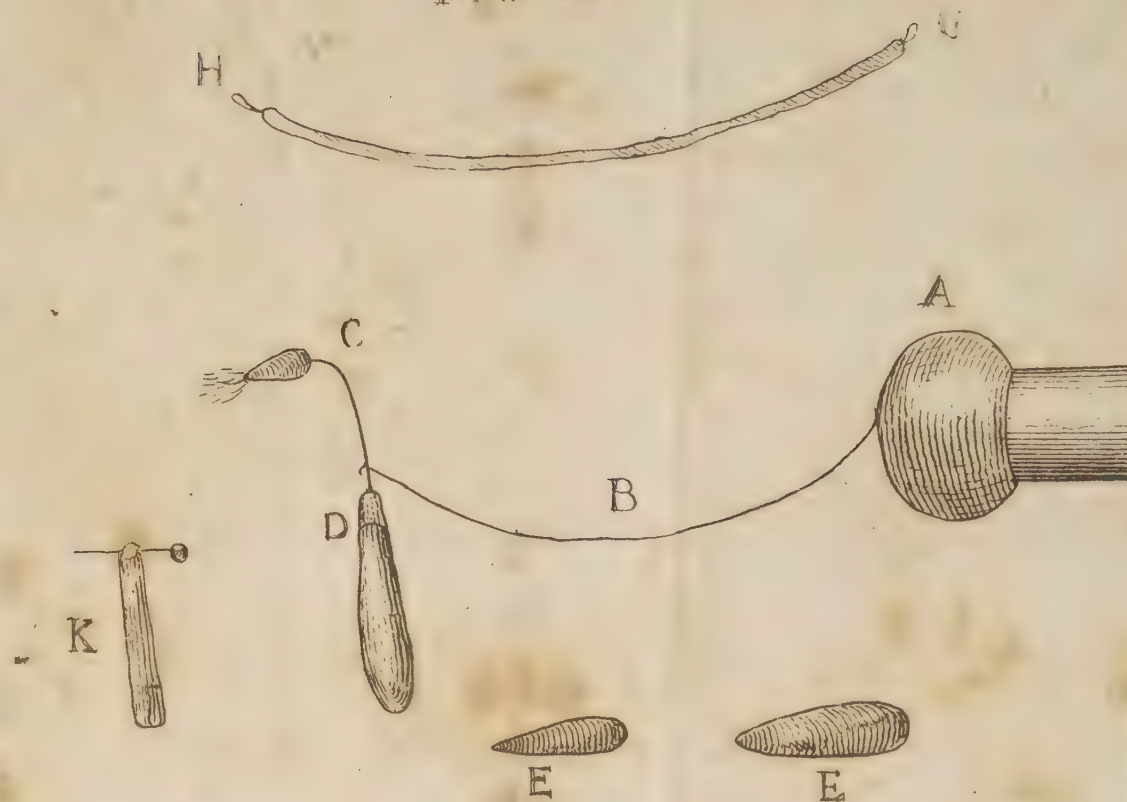


Fig 3-

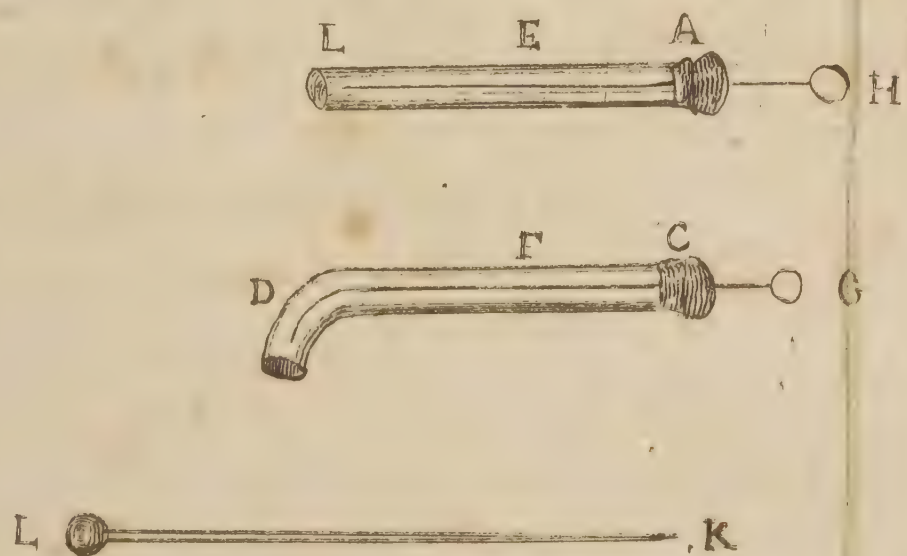


Fig 4-







